

Personal Statement

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My decision to pursue a PhD program and conduct research is deeply rooted in my academic, professional, and personal experiences. The research experience that I acquired during my final year of undergraduate studies and then as a student researcher instilled in me the desire to pursue and conduct research. When I started my undergraduate research, I understood that I thrived in analytical environments, drawn to the intensity of research frameworks and its real-world application and, reading research papers always drove me to learn more. I understood that research inherently involves tackling intricate problems, navigating unforeseen challenges, and that the journey is rarely linear. Analyzing the coupled nonlinear dynamics of a beam structure, for instance, required me to think critically, identify root causes of discrepancies in mathematical frameworks, and formulate creative solutions based on theoretical modeling. This experience sharpened my analytical skills and ability to approach problems systematically, traits essential for navigating the complexities of research and beyond. During my research I encountered several concepts beyond undergraduate level especially solving higher order time dependent nonlinear differential equations. There were times that the equations were hard to solve due to multiple factors of coupled nonlinearity. Persisting through solving the problems by collaborating with the researchers of the papers, my professor Rabindra Kumar Behera and PhD scholars helped me navigate the problems effectively. Taking a step further and attending webinars, conferences and seminars related to the research topics helped me understand the concepts. This experience taught me to embrace challenges as opportunities for learning and growth, by being resilient; an asset in any field where constant innovation and adaptation are key. I believe that research experience skills are transferable which can be applied to any research setting irrespective of the domain. There is a true joy in navigating the uncertainties of the possibility to achieve the intended results and persisting through it with many iterations. This along with the privilege to co-author in a paper that I published, with its application to engineering design and small-scale electronic devices, gave me a sense of success.

The foundation in research that I acquired in my undergraduate years led me to pursue my master's program. My interest in Artificial Intelligence (AI) and Machine Learning (ML) was piqued with the PhD level courses that I completed and due to its myriad applications in healthcare, finance, education and other fields. I took the initiative to make use of the professor's office hours by asking questions to learn about the research, and engaging in discussion within the project team and class students. This helped me to gain a deeper understanding of the concepts and course material and develop strong foundation on the underlying principles and theories which were hard to grasp at first. Going beyond the course materials by reading research papers, attending conferences, colloquium, distinguished lecture series and invited talks helped me broaden my understanding on ML and Deep Learning on language, vision, speech, and ML systems.

Juggling rigorous graduate coursework from mechanical engineering and data science with research, internships and student assistant on-campus job demanded strong time management and organizational skills. Prioritizing tasks, managing deadlines effectively, and maintaining clear documentation, ensuring efficient progress and successful project completion helped me tremendously during the process. I believe that these skills are crucial for navigating the demanding schedule of a graduate program and beyond. I experienced firsthand that research rarely thrives in isolation. Collaborating with professors, original researchers and the team on projects like the lane detection model, aspect-based sentiment analysis and the stereoscopic depth perception algorithm fostered my ability to effectively communicate complex technical concepts, exchange ideas, and work towards a shared goal. This experience honed my interpersonal skills and ability to navigate diverse perspectives, crucial for successful teamwork in any research setting.

One notable opportunity I had was to lead a team of diverse student developers while working on the Database Development Project for the Institute for Health Metrics and Evaluation (IHME) during the summer of 2022. This was the first among other opportunities that I received in an industry setting, to learn about best practices; on how to manage and store data in a database, to read and write with high performance and low latency which I understood was very crucial when building a ML pipeline. I learned how to delegate tasks, motivate my team members, and resolve conflicts constructively. It instilled in me a strong belief in the power of collaboration and teamwork. As a leader, it was critical for me to create a sense of belonging and community for individuals from diverse backgrounds encouraging open dialogue and sharing of ideas. For me, inclusive leadership meant providing a level playing ground for the team members to learn from each other. I gained expertise in how to create Entity Relationship Diagrams, analyze data, optimize database performance, and implement best practices for data integrity and consistency. Besides technical skills, working on this project required me to be adaptable and open to learning new things. The ever-changing nature of the database with its elements and properties and the need to adopt new technologies challenged me to step outside my comfort zone and continue to learn and grow. It instilled in me a lifelong love of learning and a willingness to embrace new challenges. This motivated me to complete a database management class during Fall 2022 that helped me to apply practical knowledge to the class and dive deeper into the underlying principles of relational and NoSQL databases. The course project was to build a vaccine scheduling and appointment booking application from the start with a database server to store user data on Azure cloud. This project helped me to execute queries to read the correct data from the database based on the user requirements. As a team, we effectively communicated the problem statement, objectives, and proposed solutions. We regularly shared our progress, discussed challenges, adapting our approach based on the results and limitations encountered and brainstormed solutions collaboratively.

Research often requires delving into unfamiliar territories and seizing every opportunity. During my ML internship project at Chubb on anomaly detection from Fall 2022 to Winter 2023, I independently studied and implemented a probabilistic unsupervised learning model for predicting fraud claim documents, a new approach for me. This experience fostered my self-sufficiency and initiative, equipping me with the confidence to tackle new challenges and learn independently; essential skills for any researcher who thrives on exploration and discovery. During my internship, I had the opportunity to participate in a Hackathon offering me a valuable platform to apply my technical skills and cultivate crucial soft skills that are essential for success in a collaborative research environment. As a member of a team competing with 30 teams internationally, we were among the 3 selected in the finalist category. My contributions focused on automating the manual data entry process for populating the application repository. Specifically, I built a tool with Azure form recognizer API to extract certain key entities from documents with unstructured data. This process fostered my ability to think critically, identify alternative solutions, and adapt to unforeseen circumstances. This experience honed my ability to explain complex technical concepts to diverse audiences as part of the presentation to the stakeholders. This in-turn enhanced my leadership skills, and my ability to work in a collaborative and high-pressure environment. Our automated data capture tool successfully streamlined the process of populating the repository, demonstrating a potential for significant cost reduction and increased efficiency.

Apart from my personal experience through research, during my master's program, I was actively involved in initiatives promoting community building, diversity and inclusion with Foundation for International Understanding Through Students (FIUTS), an organization for supporting students from diverse backgrounds. This led me to join their team as a Database and Student Programs Assistant. My role at FIUTS required me to analyze and automate database processes, utilizing Salesforce features like Process Builder, Flows, and Integration. This experience honed my technical skills in database management, data analysis, and automation, skills that directly translate to my research interests. I had the opportunity to learn and understand about inferring ideas and trends from the data and effectively manage the flow of data which is one of the crucial component for ML model development. I also helped initiate a plan to maintain the database for better data warehouse performance. This included implementing indexing and data cleansing techniques to help analyze and store user's data efficiently to support student groups effectively. Besides gaining technical expertise, this role has fostered a deeper understanding of cross-cultural communication, which I facilitated through events and student groups, aligning perfectly with my passion for connecting people from diverse backgrounds. This helped me further to learn and educate myself about broader areas of research interest in AI and ML from students in similar backgrounds. Having lived in three different countries has instilled in me a deep appreciation for cultural diversity and understanding. My experience at FIUTS has been instrumental in shaping my personal and professional goals. It has allowed me to combine my passion for technology with my commitment to promoting cross-cultural understanding and inclusive communities.

My undergraduate research and master's program provided me with additional research questions in AI and ML that further bolstered my interest to pursue a PhD program in this domain. Some of the research questions with its broader perspectives that I am interested to explore and solve are: (1) how can we develop more efficient, robust, safe, scalable, privacy-preserving and fault-tolerant algorithms for training large-scale deep learning models like for language models or for multimodal learning and design better optimization algorithms that are robust to noise and non-convexity, (2) how can we design and build better systems such as accelerators, that can support the training and inference of increasingly complex and large-scale deep learning models and how can we optimize it for efficient and scalable deep learning training and inference, (3) how can we develop machine learning algorithms that automatically optimizes the performance and efficiently utilizes software and hardware systems such as distributed systems and on cloud computing platforms, and (4) how can we leverage multi-task learning and transfer learning to improve the performance of AI systems across different tasks. Carnegie Mellon University's strong focus on interdisciplinary research with state-of-the-art research labs and facilities, including the Language Technologies Institute and the Machine Learning Department, would provide me with the optimal platform to conduct groundbreaking research, address these key questions, and contribute to the advancement of AI and ML.

My journey into the realm of AI and ML was a natural progression. My personal history has not only shaped my academic interests but also instilled in me the essential qualities needed for success in this program and beyond. My unwavering determination, resilience, and commitment to inclusivity will be instrumental in navigating the challenges and opportunities that lie ahead. I believe that my diverse experiences and dedication will enable me to contribute meaningfully to the field. These skills will be invaluable assets in my journey as a graduate student and future researcher, enabling me to contribute effectively to the advancement of knowledge and innovation in the field of AI. Carnegie Mellon University's diverse and inclusive student groups and organizations with the collaborative and research-intensive environment aligns well with my technical expertise and passion for innovation.

Today, as I stand on the cusp of embarking on a PhD program, I am driven by the same convictions that fueled my journey so far. I am eager to delve deeper into AI research for the intellectual challenge it presents, and for the positive impact it can have on the world, unlocking new avenues for learning. I am confident that I can contribute meaningfully to the research community at the Carnegie Mellon University and continue to develop my skills as a researcher with the guidance of renowned faculty and fellow students.